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ABSTRACT

The study investigates the relationship of theoretically relevant variables to student attitudes toward mathematics. Data on student, teacher, and learning environment variables hypothesized to be related to attitude toward mathematics were collected from 2,000 students and their math teachers at grades four, seven and nine. Over 130 variables were examined and combinations of some variables accounted for up to 84% of the variance in math attitude. Variables which most consistently showed a high level of association with mathematics attitudes were overall teacher quality, fatalism of students, and class satisfaction. Patterns of relationship for each grade level are described and implications for future research in mathematics attitudes are discussed. (Author)

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Determinants of Class Attitudes Toward Math

Joan Shaughnessy and Tom Haladyna

Teaching Research Division

Oregon State System of Higher Education

J. Michael Shaughnessy

Oregon State University

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Abstract

The study investigates the relationship of theoretically relevant variables to student attitudes toward math. Data on student, teacher, and learning environment variables hypothesized to be related to attitude toward math were collected from 2,000 students and their math teachers at grades four, seven and nine. Over 130 variables were examined and combinations of some variables accounted for up to 84% of the variance in math attitude. Variables which most consistently showed a high level of association with math attitudes were overall teacher quality, fatalism of students, and class satisfaction. Patterns of relationship for each grade level are described and implications for future research in math attitudes are discussed.

Determinants of Class Attitudes Toward Math

In the past ten years, there have been several extensive reviews of the research on student attitudes toward math (Aiken, 1970, 1976; Kulm, 1980; Shaughnessy, Haladyna, Olsen, & Shaughnessy, 1980). One of these reviews revealed that the preponderance of research identifying factors related to student attitudes toward math has concentrated on describing the association between attitude and other individual student variables, such as achievement, IQ and family background (Shaughnessy, Haladyna, Olsen, & Shaughnessy, 1980). In most of the studies reviewed data were collected from students in the classroom setting, but then the correlations or associations between variables of interest were reported using the individual student as the unit of analysis. This approach to data analysis was criticized, since it assumes that student attitude is primarily a characteristic inherent in the individual and that each student's score on an attitude measure is independent of other students' attitudes. There has been some concern that this approach to data analysis masks the social effects of participation in a classroom. Lavin (1965) protests that studies handling the data in this way are treating students as if students learn in a vacuum. Getzels (1969) suggests to researchers that classroom environment and the group atmosphere of the class may prove to be among the most powerful indicators of student variables, such as attitude.

All of the recent reviews of research on math attitude have discussed two other problem areas in attitude research: (a) the absence of theoretical models which can be used to test the relationship between attitude and other variables of interest, and (b) the lack of integrative findings about the determinants of student attitudes. The reviewers have concluded by

recommending a systematic approach to research to explore factors influencing attitudes toward math.

The present study is part of a programmatic research effort designed to examine the correlation between math attitudes and variables posited to affect the formation of these attitudes. The framework for the study is a theoretical model which hypothesizes reciprocal relationships between math attitudes and variables from three educational constructs: student, teacher, and learning environment. Once potential determinants of attitude are identified from the variables examined, research of this type can suggest teacher training methods and curriculum interventions which should improve student attitudes.

As part of this programmatic research effort, correlates of attitude toward math were examined in an earlier study, using the individual as the unit of analysis (Shaughnessy, Haladyna, & Shaughnessy, 1980). The results of that study identified the student, teacher, and learning environment variables which were related to individual student attitudes. Closer examination of the data collected on individual students revealed that class means on the student attitude measure varied widely. A re-analysis of the data was proposed to explore the hypotheses that the same variables found to be related to student attitudes for individuals might act as determinants of classroom attitudes toward math. The variables shown as promising indicators of math attitudes for individuals included:

1. fatalism--students' beliefs about their ability to determine their own success in school;
2. overall teacher quality--a composite measure of students' perceptions of their teachers' teaching ability in such areas as teacher support for the

individual student, teacher fairness, teacher commitment to learning, and teacher praise and reinforcement;

3. student self-confidence.

While other variables were related to attitude at particular grade levels studied, these three showed the most consistent association with attitude.

The present study utilizes the same variables found to be related to the individual's attitude and explores the hypothesis that the classroom responses taken collectively may be determinants of class attitude variability. In order to describe the selection of variables included in the study, the theoretical model is presented prior to the description of the research methodology.

Theoretical Model Describing Potential Determinants of Attitudes

In order to study attitudes toward the subject matter of math, and integrate the research findings of past and future such studies, a theoretical model was developed (see Haladyna & Shaughnessy, 1980, for a more complete description of this model). From the authors' perspective, a developed theory requires that (a) constructs are defined, (b) relationships are hypothesized among constructs, (c) measures are identified which represent these constructs, and (d) all research can be utilized to test the truthfulness of these hypotheses and, subsequently, the theory. Successful theory development enhances practical applications of the theory in a classroom setting. If determinants of attitudes can be identified, then instructional programs and methods can be devised to positively affect attitudes. The proposed theoretical model is a first attempt at generating a fully developed model of attitude determinants.

The research described in this paper is an attempt to provide supportive evidence for the theoretical model. The model is organized along two

dimensions, content and focus. Content refers to one of three categories: student, teacher, or learning environment. Virtually all studies of students' attitudes toward math have employed variables which can be classified into one of these three categories (Shaughnessy, Haladyna, Olsen, & Shaughnessy, 1980). Student variables involve any indicators which are inherent to the student and not a part of a larger context. Teacher variables are indicators that are unique to each individual math teacher. Learning environment variables are characteristics of a particular learning experience which can be effected by either students or teachers or a combination of both. They include variables identified in research on learning and classroom environment conducted over the past decade by Walberg and his colleagues (Anderson & Walberg, 1976; Walberg, 1979) and Moos and his colleagues (Moos & Moos, 1978; Moos & Trickett, 1974). Perhaps the best known operational definition of the learning environment can be found in the Learning Environment Inventory (LEI) introduced by Anderson and Walberg (1976) and used in literally hundreds of studies. In the LEI, 14 unique scales have been identified ranging from class cohesiveness to empathy.

The second dimension, focus, refers to the location of the variable. Exogenous variables are those which are found outside the immediate influence of the school process. These variables include teacher's age, gender of student, physical condition of the school building, and socioeconomic status of the neighborhood where the class members reside. Exogenous variables are "givens" in the schooling process and may not be manipulated to produce changes in attitudes.

On the other hand, endogenous variables can be manipulated and may produce changes in attitudes. Such variables reside within the schooling

process and are often under the direct control of the teacher. These variables include student self-confidence, class organization, teacher praise and reinforcement of students, among many others. Each of these variables is potentially causally related to attitudes toward math, and the strengths of these relationships have not been determined in previous research.

These exogenous and endogenous variables across the dimensions of content are shown in Figure 1. The arrows indicate the causal direction of these constructs. For example, it is believed that the teacher has a direct influence on student attitudes. This influence can be attributed to overall teacher quality and, more specifically, to such traits as praise and reinforcement, fairness, and respect for the teacher. It is hypothesized that the learning environment is directly influenced by the teacher and it, in turn, influences the student's attitude toward math. Such variables as classroom organization, goal direction, difficulty, among others, seem to be related to attitudes toward math. Finally, it is believed that student endogenous variables are also causally related to math attitudes, but that these variables are more resistant to change through interventions in the school. These hypotheses remain to be tested.

Insert Figure 1 about here

The present study deals with the relationships of exogenous and endogenous student, teacher, and learning environment variables to attitudes toward math. The premise underlying this study is that despite prevailing individual student attitudes which may result from long-term effects of schooling, a combination of the teacher and the learning environment factors in a math classroom may have much to do with the modification of attitudes

at the classroom level. If this is true, then programs of classroom intervention may be developed which can affect attitudes of groups of students. More importantly, the research serves to establish a basis for the notion expressed in the theoretical model, that the classroom teacher is a key element in developing positive or negative attitudes.

Research Questions

As a consequence of the foregoing analysis, the following questions served as the basis for this study.

1. What are the most significant student, teacher, and learning environment correlates of class math attitudes?
2. What are the relative contributions of endogenous student, teacher, and learning environment variables to math attitudes?
3. Which set of variables is most relevant to math attitudes, regardless of how the variable is classified?

Method

Sample

Students in grades four, seven, and nine participated in this study. The sample sizes and exogenous variables of this sample are presented in Table 1. As shown there, the sample varies widely with respect to family mobility, socioeconomic status, television viewing habits, and school attendance. The sample does not vary much with respect to family background, as only 10.4% to 14.3% of the sample were listed as non-white.

Insert Table 1 about here

The sample was drawn through a stratified, random sampling plan which controlled for size of district and size of school at each grade level and

region of a state. The criteria for the stratification variables varied from grade level to grade level and were based on demographic information found in the Oregon School Directory, a comprehensive source of information about schools and school districts in the State of Oregon. The intent was to sample from schools that widely represented urban and rural locales, and school environments that varied widely.

Instruments¹

Two versions of an instrument were expressly designed to tap many aspects of the theoretical model within practical constraints. These constraints were that the instrument would be administered within 30 minutes of classroom time and yield dependable measures of the important variables representing each of the three major content dimensions.

The Inventory of Affective Aspects of Schooling (IAAS) was the result of this development. The origins of items and scales of the IAAS are varied. For example, attitude scales were adapted from a self-report attitude inventory (Haladyna & Thomas, 1979), while measures of the learning environment came from the Learning Environment Inventory (Anderson & Walberg, 1976). A version appropriate for grade four, the My Class Inventory, also developed by Anderson and Walberg (1976), was modified and used at that level. Some scales were obtained, with permission of the publisher, from the Classroom Environment Scales (Moos & Trickett, 1974). Many demographic items and other items were either adopted or adapted from earlier research instruments reported in the literature or taken from the National Assessment of Educational Progress' numerous item collections. The variables yielded by the IAAS are listed in Table 2. More information about these scales may be obtained from the Manual for the Inventory of Affective Aspects of Schooling (Haladyna & Shaughnessy, 1980).

Insert Table 2 about here

The version of the IAAS appropriate for grade four yielded 28 predictor variables across four categories of variables: (a) exogenous student, (b) endogenous student, (c) endogenous teacher, and (d) endogenous learning environment, as shown in Table 2. The criterion variable was attitude toward math. The alpha internal consistency reliability estimate for the attitude measure was .90 for grade four, .79 for grade seven, and .78 for grade nine.

The IAAS was subjected to a construct validation study by Haladyna, Shaughnessy, and Olsen (1980). Results indicated that many variables possessed high to moderate degrees of internal consistency, but there was mixed evidence as to the discriminability of some measures. For example, for the measure, overall teacher quality, the variables numbered 17-20 in Table 2 were actually aspects of overall teacher quality. Thus, a high degree of overlap is expected in correlational studies involving all of these variables.

The instrument appears to possess sufficient evidence to suggest its use to obtain construct valid interpretations with the populations intended, but caution should be exercised in interpreting some of the variables based on fewer items due to lower reliability and the apparent overlap of some variables.

A secondary source of information was a questionnaire that was administered to the teacher. This teacher inventory contains items tapping a wide variety of areas, most of which fall into the categories of exogenous

and endogenous teacher variables. Since there was no validation study of this instrument, results were expected to be rather limited. The instrument yielded 97 variables, and it was believed that many of these variables had the potential to be highly related to attitudes beyond what information could be derived from the IAAS. Therefore, the results of the administration of the teacher inventory were included.

Procedures

School district personnel were contacted and informed of the purpose of the research. Written permission to conduct the research was obtained from district administrators before building principals were contacted. These building principals had to give permission before teachers at each building could be contacted. Once teachers had been contacted and permission to collect data had been obtained, a test administrator, trained in the use of the IAAS, visited the classroom and administered the instrument. The teacher was asked to leave the classroom and complete a teacher questionnaire. For grade four, items were read to all students. For grades seven and nine, the IAAS was self-administered. Individual assistance was offered for those who experienced difficulty in the reading of items.

Data were eliminated from students who chose not to participate or who completed only a part of the inventory. Most students participated in the exercise and cooperated. All responses were anonymous to encourage honest responding and insure confidentiality.

Analysis of Data

Two types of analyses were conducted. First, product-moment correlations were computed between all predictor variables and the criterion of science attitudes, using the class mean as the unit of analysis. There were

27 correlations for grade four and 37 for grades seven and nine where the student was the source of information and 97 correlations for grades four, seven, and nine where the teacher was the source of information.

Since the number of classes used in the analyses was rather small, ranging in size from 28 to 38, the criterion for rejecting the null hypothesis that the correlation was zero was .10. All statistical hypotheses were directional, one-way, as the sign of the correlation was predicted from the model. The reason for the adoption of this rather high alpha level was that with the small sample sizes, some moderate-sized correlations tend not to be statistically significant. Using a directional hypothesis and a higher alpha level maximizes the rejection of the null hypothesis and results in some of these moderate-sized correlations being reported at the risk of falsely rejecting correlations that may have occurred by chance alone. In instances where correlations were statistically significant but unexplainable by the model, these results are viewed alternatively as (a) negative evidence or (b) the result of a chance occurrence, a Type I error.

When a high number of correlations are computed, and alpha is set at .10, we would expect to commit a Type I error, that is, falsely reject the null hypothesis, about 10% of the time. With 125 correlations at grade four, and 142 correlations at grades seven and nine, we would expect from 12 to 14 correlations to be significant by chance alone. Therefore, the binomial probability distribution was applied to estimate the probability of obtaining the observed number of significant correlations actually detected or higher. This probability should be less than .05. If it is, then we can safely conclude that the preponderance of these correlations is truly indicative of relationships rather than attributed to the random variability of correlations.

In the second type of analysis, regression analyses were performed to determine the relative strength of association of various sets of predictors organized by the constructs of student, teacher, and learning environment. For instance, all learning environment variables were entered in the regression analyses in sequential fashion with an F -test being used as the basis for accepting or rejecting the variable as a contributor to attitude variance. Alpha was set at .05 for this test. For each of three constructs, a "best set" of predictor variables was derived, and the resulting squared multiple correlation coefficient (R^2) represented the percentage of criterion variance accounted by this set of variables.

A final step involved the use of all variables to determine a "best set" that included members from all three constructs. In this analysis we would weigh the importance of each construct in explaining the variance of the math attitude scores.

Results and Discussion

Correlation

Lists of the variables which correlate significantly with classroom attitude are presented separately for each grade level studied (Tables 3, 4, and 5). The variables on each list are also separated into the three construct categories: student, teacher, and learning environment, and within each category are subdivided into exogenous and endogenous variables.

For fourth grade classrooms, as shown in Table 3, only 21 of the 125 correlations possible were statistically significant. This is slightly more correlations than the 12 to 14 which would be expected by chance. The variables correlating most strongly with positive class attitudes were in the endogenous teacher and endogenous learning environment categories. These

included five variables with the teacher as the data source: teacher's professional membership ($r = +.57$); professional activities ($r = +.45$); frequency of classroom discussion ($r = +.57$); frequency of testing in math ($r = -.48$); and teacher's report on the duration of math instruction in their class ($r = +.45$). In fact, of the 14 endogenous teacher and learning environment variables significantly correlated with class attitude, 10 were factors derived from the teacher inventory. This was a surprising result, since the teacher survey's value as a research instrument was untested. The correlations of these 10 variables ranged from .27 to .57 and most of these were readily explainable by the theoretical model.

Insert Table 3 about here

In the elementary grades, it seems plausible that classes with positive attitudes toward math would be taught by teachers who affirm their interest in math by reading more professional journals in mathematics, joining and participating in math education associations, and by conducting lengthier and more discussion-oriented class sessions on math content. It must be remembered that most elementary teachers are not mathematics specialists. The data suggest that elementary teachers who do actively pursue an interest in mathematics might help their students develop a positive attitude. The classes with positive attitudes also have teachers reporting that they gear their classes toward student interests and encourage student expression of opinions.

In the endogenous learning environment category for grade four, it is notable that data from both teachers and students supported the finding that math classes of less difficulty were characterized by more positive attitudes.

This is consonant with the finding of a negative relationship between frequency of testing and math attitudes.

Only one exogenous variable, student gender, correlated significantly with fourth grade attitudes, and this correlation was relatively weak ($r = .27$). In contrast, student endogenous variables made a stronger showing with four variables identified with moderate relationships to attitude, including factors reflecting students' perceptions of the importance of math and of grades, and students' beliefs about their own abilities (self-confidence and fatalism).

At the seventh grade level, as indicated in Table 4, 29 statistically significant correlations were identified out of 145 possible correlations. The strengths of the correlations were substantially higher than in grade four, ranging up to .78 between overall teacher quality and math attitude. The strongest associations were again mainly in the endogenous teacher category, with several high correlations in the endogenous learning environment and the endogenous student categories. As hypothesized, significant correlations with exogenous variables were infrequent.

Insert Table 4 about here

The three endogenous student variables with significant correlations (importance of math, fatalism, self-confidence) were ones also noted in the fourth grade data, although the correlations were stronger at the seventh grade level. Among the endogenous teacher variables, the overall teacher quality variable and its subscales (fairness, teacher support, praise) again showed stronger correlations at this grade level, while the influence

of teacher professional activities and membership disappeared. It is presumed that teacher commitment to math does not vary as greatly at this grade level, since all math teachers at the seventh grade level have self-selected math as an area of concentrated preparation.

One unanticipated relationship to class attitude was associated with a one-item scale asking if teachers have an earth-science norm. This finding is difficult to explain, in light of the small sample size of teachers, and it is likely a chance occurrence.

Twenty-four endogenous learning environment variables correlated with class attitude appeared with all but three of them derived from the student questionnaire. This contrasts sharply with the fourth grade findings in which the teacher inventory served as the primary identifier of relevant learning environment variables. Because it is difficult to discuss so many learning environment variables separately, it is helpful to group them into two separate factors: (a) the social-psychological context and (b) the classroom organization factor. The first includes variables dealing with emotional reactions to the learning environment, while the second centers on variables reflecting classroom structure and activities.

In the seventh grade data, about half of the significant correlations were with social-psychological variables. These included satisfaction, .72; enjoyment of classmates, .65; class environment, .55; school-wide environment, .48; favoritism, -.44; and friction, -.40. Although there were as many organizational variables correlating with attitudes, the correlations noted were more moderate, with the strongest relationship at .62 for class attentiveness to task. Other organizational variables noted were approval of class materials used, .57; disorganization, .56; emphasis on class speed, .55;

goal direction, .50; and formality (rule orientation), -.42. From the number of significant correlations identified at this grade level, it would appear that a positive learning environment in a math class is closely linked to student attitudes toward math.

Several of the same relationships noted in seventh grade are again apparent in the ninth grade classes, although there were more of significant correlations ($N = 41$), as shown in Table 5. First, overall teacher quality and its subscales again show a strong relationship to attitude. Secondly, both the social-psychological and the organizational aspects are represented among the correlations in the endogenous learning environment category. Third, two of the same endogenous student variables are correlated with attitude (fatalism and self-confidence), although at this grade level the correlations are stronger and the influence of importance of the subject math diminishes.

Insert Table 5 about here

There are several different findings at grade nine. For the first time three exogenous student variables show strong relationship to math attitude. Parental involvement is the most prominent of these ($r = .73$). Also, correlations involving variables regarding teacher involvement in professional activities reappear as they did in the fourth grade.

Teachers with confidence in their own competence to teach math and who viewed their students as being more capable also tended to have classes with more positive attitudes. Since the ninth grade classes sampled included a variety of classes ranging from general math to college preparation classes, it is possible that some of these findings may reflect the tendency for

teachers to be assigned to college prep classes with more extensive college preparation. Also, students in the college prep classes may be the ones who evoked more favorable teacher opinions of students.

Almost all of the correlations between class attitudes and endogenous learning environment variables were in the anticipated direction. The one exception to this is the finding that classes where more homework was assigned were those with more positive attitudes. This correlation is supported by the significant positive correlation between attitude and the endogenous student variable, amount of homework done. A question asking students to describe the nature of homework assignments might have provided additional insight into these positive correlations; however, the only information on homework collected on the IAAS related to amount of homework assigned or completed. It is recommended that future studies at this grade level attempt to examine these relationships more carefully by collecting additional data about homework.

Regression Analyses with Each Category

The second research question dealt with the relative contributions of each category of variables when accounting for classroom variance in math attitudes. To answer this question five regression analyses were done at each grade level, one for each variable category. The results of these analyses can be found in the right-hand columns of Tables 3, 4, and 5.

No significant percentages of variance in class attitude can be attributable to exogenous student variables in grades four or seven. However, the importance of an exogenous student variable is notable in grade nine, where 53% of the variance can be accounted for by the parental involvement factor.

The strength of the contribution made by endogenous student variables shows a consistent increase from grade four, where only 15.8% is attributable

to student perceptions of the importance of math, to grade nine, where fatalism contributes to 67.2% of the variance. This shift suggests an erosion of the classes' beliefs about their own ability in math and an increase in a sense of futility about math. This finding was noted in earlier research, where the individual student was the unit of analysis (Shaughnessy, Haladyna, & Shaughnessy, 1980).

The influence of the endogenous teacher variables is strongest at the higher grade levels where these factors contribute to 72.7% of the variance at grade nine and 83.8% at grade seven. While the teacher variables emerge as most important in the seventh grade, the endogenous learning environment variables are still influential for grade seven where 70% of the variance is attributable to three variables. Satisfaction is the strongest entry here, but two organizational variables, attentiveness and pacing, contribute a respectable 14.6% of the criterion variance. At the ninth grade level two social-psychological variables account for 73% of the variance with no influence of organizational variables identified. The learning environment variables also show the strongest influence of any group of variables in the fourth grade where they account for 60.7% of the variance.

"Best Model" Regression Analyses

The final step in the analysis was to enter all significantly correlated variables in all three categories into the regression analysis. Table 6 lists the variables at each grade level which are the strongest contributors to criterion variance. At the fourth grade level, 58.9% of the variability in classroom attitudes toward math is attributable to three variables: teacher professional membership, overall teacher quality, and grouping for instruction. Note that all of these variables are under the direct influence of educators.

Insert Table 6 about here

At the seventh grade level, five variables enter into the model, accounting for 85.9% of the classroom variability. All five of these variables are in the teacher category, suggesting that characteristics of teachers at this grade level have a strong influence on the attitude of the class. Four of the five teacher variables in the best model have the student as the source of the data, emphasizing the importance of student perceptions of the teacher at the junior high level. The fifth teacher variable entering the model is the certification variable relating to earth science which was discussed earlier in the correlation section. A plausible explanation for the inclusion of this variable has eluded the researchers, and its appearance must be attributed to the occasional quirks of data in small samples.

The best model for ninth graders shows a startling shift in influential variables. Here only two variables enter the model accounting for 78.9% of the variance, yet neither of these variables is a teacher variable. For the first time in this table of best models a student variable is identified as contributing to the variance in classroom attitude. The student variable, fatalism, singularly accounts for 67% of the classroom variance in the ninth grade. The second variable, satisfaction, accounts for the additional variance.

Conclusions and Implications

The data reported in this study support the theoretical model's contention that a variety of educational variables are related to classroom attitudes. At this point in our program of research, it is unclear what role

each of these variables play in attitude development and which are the result of attitudes already formed. It is likely, though, to assume that the contributions of variables may differ from grade to grade.

Each of the grade levels studied shows a slightly different pattern of influential variables. In the fourth grade the learning environment variables made the most substantial contribution to the criterion variance, while in the seventh grade classes, teacher variables are most prominent. In the ninth grade a student variable, fatalism, was identified as the most influential factor. These findings follow a similar pattern to those identified in research studies examining class attitudes toward science (Haladyna, Olsen, & Shaughnessy, 1980) and social studies (Haladyna, Shaughnessy, & Redsun, 1980). In all of these studies fatalism is more strongly correlated to students' attitudes in the higher grades, and seventh grade attitudes are closely related to teacher variables. Possible explanations for these findings are that seventh graders have only recently been introduced to the "subject specialist" teacher and their attitudes toward a subject are strongly colored by their reactions to the teacher. In contrast, the attitudes of ninth grade classes are strongly entrenched in the individual student after years of exposure to a subject, and their feelings about school subjects may be related to their opinion about their own capabilities.

Another finding is that learning environment variables were strong contributors to the model at all grade levels. An earlier study using the Learning Environment Inventory (LEI) reported that from 10 to 37 per cent of class variance in student interest in physics could be attributed to measured environments (Walberg, 1970). In this study a considerably greater per cent of the variance (from 66% to 73%) was accounted for by these variables.

Clearly, the expansion of learning environment variables beyond those measured by the LEI has been fruitful. This finding is taken as support for the capability of the IAAS to describe many learning environment variables which are associated with student attitudes.

This study also has implications for future research on attitudes. Research exploring math attitudes and program innovations designed to improve those attitudes have been areas of growing interest in recent years. Kulm (1980) speculates that math educators have recognized the need to foster positive attitudes in hopes of encouraging students to continue on to advanced training in math. A great number of students well educated in math will be a necessity in a computer-managed society of the future. The factors found to be related to attitudes in this study will serve researchers by providing clues about variables contributing to attitude change or formation.

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Footnotes

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¹Copies of both versions of the instrument and the manual can be obtained from Tom Haladyna, Teaching Research, Monmouth, Oregon, 97361.

Table 1

Characteristics of the Sample of Fourth, Seventh, and Ninth Grade Students

	<u>Fourth</u>	<u>Seventh</u>	<u>Ninth</u>
1. Sex: Boys	297	359	409
Girls	290	405	321
2. Family Background			
a. American Indian	5.3%	6.2%	4.4%
b. Oriental	2.4	2.4	0.8
c. Black	1.4	0.7	0.4
d. White	86.8	87.5	91.4
e. Mexican-American	2.6	2.0	2.5
f. Mixed	1.5	1.3	0.5
3. Family Mobility (times moved since first grade)			
a. Never moved	37.1	23.5	20.4
b. One	19.6	21.8	21.6
c. Two	12.8	13.1	13.5
d. Three	12.3	12.0	13.2
e. Four	6.5	10.1	8.0
f. More than four	11.8	20.6	23.2
4. Socioeconomic Status			
mean	8.7	9.5	9.4
s.d.	2.7	2.2	2.4
range	0-12	0-12	0-12
5. Average TV Viewing			
a. None	1.7	2.1	2.6
b. Less than one hour	11.9	9.5	11.0
c. 1-2 hours	16.9	17.9	22.9
d. 2-3 hours	20.3	30.7	30.9
e. More than 3 hours	49.2	39.6	32.6
6. Self-Reported School Attendance			
a. 0-3 days	44.5	39.1	30.0
b. About one week	24.5	28.9	28.5
c. About two weeks	14.1	19.6	18.2
d. About three weeks	16.9	12.5	20.9

Table 2
Predictor Variables¹ of the Study

<u>Exogenous Student Variables</u>	<u>Endogenous Learning Environment Variables</u>
1. Family Mobility	21. Class Satisfaction
2. Socioeconomic Status	22. Friction in Class
3. Amount of TV Viewing	23. Difficulty
4. School Attendance	24. Cohesiveness
5. Parental Involvement	25. Competition
6. Parental Concern	26. School Environment
7. Parental Perception of Importance of Schooling	27. Enjoyment of Classmates
	28. Amount of Homework Assigned
<u>Endogenous Student Variables</u>	29. Cohesiveness
8. Self-confidence in Ability to Learn	30. Formality
9. Fatalism	31. Speed
10. Concern for Grades	32. Class Environment
11. Importance of Subject Matter	33. Attentiveness
12. Amount of Homework Done	34. Friction
13. Plans for the Future	35. Goal Direction
<u>Endogenous Teacher Variables</u>	36. Favoritism
14. Overall Teacher Quality	37. Cliques
15. Teacher Enthusiasm for Subject	38. Competitiveness
16. Respect for Teacher	39. Satisfaction
17. Support for Individual Student	40. Disorganization
18. Praise and Reinforcement	41. Difficulty
19. Commitment to Helping Student Learn	42. Apathy
20. Fairness to Student	43. Diversity
	44. Materials Usage

¹ Variables 13 and 29-44 are found only in seventh and ninth grade data.

Table 3

Correlations and Regression Analyses for Classes of Predictor Variables
for Grade Four (N = 28)

Variables	Source ¹ of Data	Correlation ² with Criterion	Rank in Model	Per Cent of Accounted Variance
<u>Exogenous Student</u>				
Gender	S	27		
<u>Endogenous Student</u>				
Importance of Math	S	40	1	15.8
Self-Confidence	S	36		
Fatalism	S	36		
Concern for Grades	S	32		
<u>Endogenous Teacher</u>				
Professional Memberships	T	57	1	32.2
Overall Teacher Quality	S	47		
Professional Activities	T	45		
Importance of Math	T	42		
Respect for Teacher	S	41		
Student Centered Instruction	T	35		
Satisfaction with Students	T	30		
<u>Endogenous Learning Environment</u>				
Class Discussions	T	57	1	32.2
Frequency of Testing	T	-48		
Difficulty	S	-44	3	55.5
Duration of Instruction	T	45	2	47.6
Student Grouping	T	42	5	66.7
Satisfaction with Class	S	41	4	60.7
Frequency of Instruction	T	35		

¹ "S" is Student; "T" is Teacher.

² Decimals omitted.

Table 4

Correlations and Regression Analyses for Classes of Predictor Variables
for Grade Seven (N = 34)

Variables	Source ¹ of Data	Correlation ² with Criterion	Rank in	Per Cent of Accounted Variance
<u>Exogenous Student</u>				
Gender	S	30		
<u>Endogenous Student</u>				
Importance of Math	S	65	1	42.7
Fatalism	S	-60		
Self-Confidence	S	41		
<u>Exogenous Teacher</u>				
Coursework (Lower Division)	T	31		
<u>Endogenous Teacher</u>				
Overall Teacher Quality	S	78	1	60.4
Fairness	S	77		
Teacher Support	S	73		
Respect for Teacher	S	71		
Commitment to Help Students				
Learn	S	70	3	72.8
Praise and Reinforcement	S	59	4	79.1
Enthusiasm	S	43	5	83.8
Earth Science Norm	T	37	2	69.5
<u>Endogenous Learning Environment</u>				
Satisfaction	S	72	1	51.2
Enjoyment of Classmates	S	65		
Attentiveness	S	62	3	70.0
Materials Usage	S	57		
Disorganization	S	-56		
Speed	S	55		
Environment	S	55		
Goal Direction	S	50		
School Environment	S	48		
Favoritism	S	-44		
Formality	S	-42		
Friction	S	-40		
Homework Assigned	S	37		
Diversity	S	31		
Reputation of School	S	31		
Pacing of Instruction	S	27	2	64.6

¹ "S" is Student; "T" is Teacher.

² Decimals omitted.

Table 5

Correlations and Regression Analyses for Classes of Predictor Variables
for Grade Nine (N = 38)

Variables	Source ¹ of Data	Correlation ² with Criterion	Rank in Model	Per Cent of Accounted Variance
<u>Exogenous Student</u>				
Parental Involvement	S	73	1	53.0
Socioeconomic Status	S	47		
Parental Concern	S	40		
Television Viewing	S	32		
<u>Endogenous Student</u>				
Fatalism	S	82	1	67.2
Self-Confidence	S	77		
Importance of Math	S	68		
Concern for Grades	S	56		
Amount of Homework Done	S	53		
<u>Endogenous Teacher</u>				
Respect for Teacher	S	77	1	59.4
Overall Teacher Quality	S	76		
Support for Individuals	S	75	2	72.7
Fairness to Students	S	72		
Commitment to Help Students Learn	S	71		
Teacher Enthusiasm	S	62		
Praise and Reinforcement	S	60		
Perception of Students' Ability to Learn	T	52		
Teacher's Opinion of Students	T	49		
Preparation to Teach Math	T	41		
Attendance at Professional Meetings	T	40		
Competence to Teach Math	T	36		
Sources of Information About Teaching Math	T	32		

Endogenous Learning Environment

Satisfaction	S	79	1	62.1
Enjoyment of Classmates	S	72		
Environment	S	71		
Competition	S	67		
Attentiveness	S	67		
Goal Direction	S	66		
Disorganization	S	-65		
Favoritism	S	-60		
Friction	S	-59		
Apathy	S	-56		
Materials Usage	S	52		
School Environment	S	51		
District Support for Teacher	T	47		
Project/Activities	T	45		
Formality	S	-44	2	73.0
Homework Assigned	T	-44		
Cliqueness	S	42		
Difficulty	S	-42		
Diversity	S	38		

¹ "S" is Student; "T" is Teacher.

² Decimals omitted.

Table 6

Regression Analysis Where all Variables Were Entered Sequentially

Best Model

Variables	Source of Data	Type of Variable	Rank in Model	Cumulative Percentage of Accounted Variance
<u>Grade Four</u>				
Professional Membership	T	T	1	32.2
Overall Teacher Quality	S	T	2	51.7
Grouping for Instruction	T	LE	3	58.9
<u>Grade Seven</u>				
Overall Teacher Quality	S	T	1	60.4
Teaching Norm (Science)	T	T	2	69.5
Importance of Math	S	T	3	74.9
Commitment to Help Students Learn	S	T	4	81.0
Teacher Enthusiasm	S	T	5	85.9
<u>Grade Nine</u>				
Fatalism	S	S	1	67.0
Satisfaction	S	LE	2	78.9

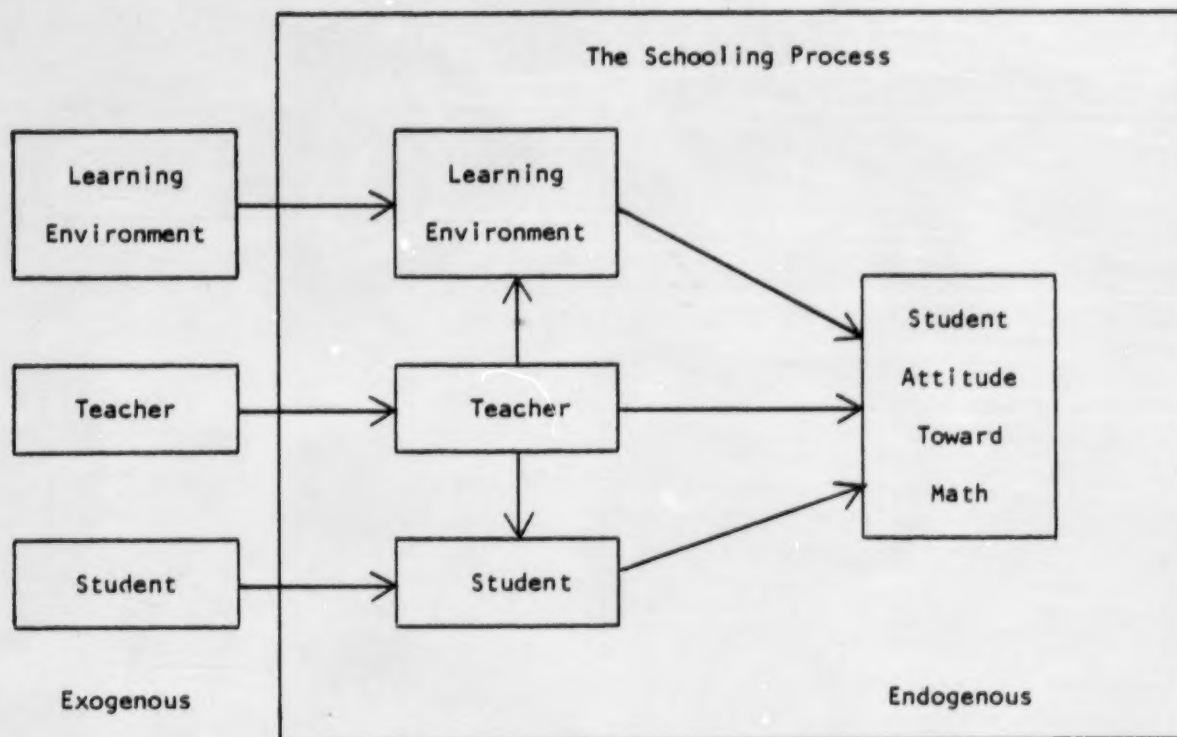


Figure Caption

Figure 1. Illustration of the roles of exogenous and endogenous variables on attitudes toward math.